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Research

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FIRST CALF BORN FROM SYNTHETIC DIET–Page 8

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Backstopping Research

While making his rounds of animal husbandry research barns recently at Beltsville, Md., a herdsman found a heifer calf lying dead in its pen. The loss of the Angus calf was a serious blow to scientists who were using it as part of long-term basic studies on animal nutrition.

The research is fundamental to learning more about how cattle utilize various feed components (page 8, this issue). But the death of the calf—even though a research setback—pointed up something equally as fundamental: Scientists must act promptly to backstop research, whether within a single study or in protecting previous research results.

The Beltsville animal husbandmen moved quickly. They located a proxy calf of almost identical age and weight as the dead calf and sired by the same bull. Serving as a substitute, the new calf will permit the studies to continue—and will protect research dollars.

Similar backstopping goes on across a wide range of agricultural research. What good would be corn hybrids that resist European corn borer, for example, if the parasitic witchweed were permitted to spread to the Cornbelt, where it could wipe out entire fields?

ARS plant pest control workers have, since 1956, confined witchweed to a two-State area of the Southeast (page 6, this issue). By so doing, they are backstopping decades of work and many research dollars spent on breeding improved corn varieties.

ARS and Mississippi scientists have obtained from a relative of the cotton plant a water-soluble extract that repels boll weevils when the extract is applied to cotton squares (page 14, this issue). This repellent substance might well be developed as a backstop control in case weevils develop resistance to insecticides.

Scientists know that chemicals—particularly the selective types—are usually the most efficient tool for destroying screwworm flies when the pest population is high. The sterile insect release method is, by contrast, most efficient when screwworm numbers are low. With one backstopping the other, a much superior pest control program is possible.

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Orville L. Freeman, Secretary
U.S. Department of Agriculture

B. T. Shaw, Administrator
Agricultural Research Service

Aluminum Tolerance

HOW IS IT INHERITED?

■ ARS soil scientists and agronomists have made basic findings they hope will lead to an understanding of *how* resistance to aluminum toxicity is inherited in wheat and barley varieties.

Some of the present commercial wheat and barley varieties have good tolerance to aluminum toxicity, but a thorough understanding of the genetics of this characteristic would be a highly valuable tool in plant breeders' hands—it would permit selection specifically for resistance.

There is a good possibility, the scientists feel, that the research will lead to advances on a much broader front—perhaps to other crops and to other toxicity problems.

Varieties of wheat that were most tolerant to aluminum in acid soil produced far more top growth and roots. From left, above, are Atlas 66, Monon, Thatcher, and Gaines; from left, at right, are Atlas 66, Gaines, and Thatcher.

Aluminum toxicity is present in much of the Southeastern United States, and in other parts of the world where soil is acid and high in aluminum.

Genetics of aluminum toxicity resistance is being studied at Beltsville, Md. in barley by agronomists D. A. Reid and in wheat by L. W. Briggle. This research is an outgrowth of a series of earlier Beltsville studies by soil scientists C. D. Foy, G. R. Burns, and J. C. Brown, and technician (chemistry) A. L. Fleming.

In one of these earlier experiments, the soil scientists found *why* some wheat and barley varieties are more aluminum tolerant than others: Roots alter pH in their immediate vicinity, and the altered pH around the roots of tolerant varieties is higher than the altered pH around the roots of susceptible varieties. The lower pH around the roots of the susceptible varieties causes more aluminum to go into solution—and this extra amount of aluminum causes toxicity (AGR. RES., December 1964, p. 3).

Reid and Briggle recently collaborated with Foy and agronomist W. H. Armiger to determine the range of aluminum tolerance in 26 wheat and 15 barley varieties. Range of tolerance is a good indicator of the chances scientists have to pinpoint the genetics of aluminum resistance. The greater the degree of tolerance, the greater is their hope of success.

The researchers found, in fact, that there is a *wide* range in the aluminum tolerance of the varieties tested.

This range was determined by growing plants in soil that is naturally acid and high in aluminum, then harvesting and weighing their tops and roots. The wheat plants were harvested 50 days after seeding; barley plants, 62 days.

Wheat varieties had a wider range in yield than barley varieties. The most tolerant wheat variety produced about 12 times as much top growth and 7 times as much root growth as the most susceptible variety. The most tolerant barley variety produced about nine times as much top growth and four times as much root growth as the most susceptible variety.

To confirm their conclusion that the wide growth range was due to differences in aluminum tolerance—and not due to differences in the normal growth habits of the varieties—the scientists grew representative tolerant and sensitive varieties under four conditions:

1. In Tatum soil, which is acid

Top and root growth of aluminum-tolerant Atlas 66 was several times greater than that of Thatcher when both grew on unlimed acid soil that was high in aluminum (pair of plants at left in both photos). When the same varieties grew on the same soil that had been limed, Thatcher grew as well as Atlas 66 (pair of plants at right, both photos).

and high in soluble aluminum.

2. In Tatum soil that was limed to take most of the aluminum out of solution.
3. In a nutrient solution high in soluble aluminum.
4. In a nutrient solution with no aluminum.

When the concentration of soluble aluminum in the soil or the solution was high, varieties differed widely in growth. When soluble aluminum was absent or at a low level, all varieties grew well.

Now that the ARS scientists know that aluminum resistance is genetically controlled, they hope to select specifically for this characteristic. This would be an important new tool because the greater the number of desirable genes the plant breeder has at his command, the greater are his chances of developing varieties with superior *combinations* of characteristics.☆

Testing a technique...

against..

■ Encouraging reports have been received from a team of researchers in Africa studying the possibility of sterilizing tsetse flies to control one of the world's worst disease-spreading insects.

ARS entomologist D. A. Dame, who leads the investigation, indicates that initial success has been achieved in sterilizing the fly by treating either the pupal or the adult stage with chemosterilants. Sterilization was accomplished without causing serious damage to the insect.

Twenty-three known varieties of tsetse fly spread death and disease in areas of Africa that are considerably greater in size than all of the United States. They carry disease-causing trypanosomes, which parasitize the blood and produce sleeping sickness in humans and nagana in livestock.

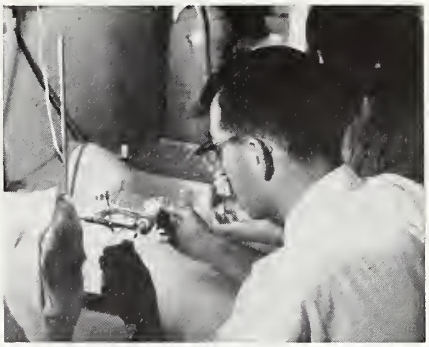
So severe is the infestation that vast areas of Africa can support no domestic animals except poultry.

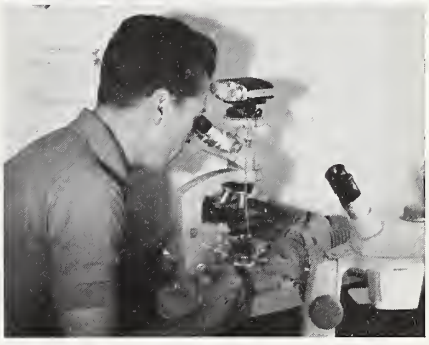
Although effective drugs are available against trypanosomes in animals and one strain of the blood parasite in man, eradication of the tsetse fly is the only realistic way to combat trypanosomiasis.

The current tests, sponsored by the Agency for International Development, are conducted jointly by ARS and the Agricultural Research Council of Central Africa (ARC) in Southern Rhodesia. The research team hopes to determine if the sterile-male-release technique will work on the tsetse fly. In this method insects are reared, sterilized, and released to mix with wild populations of the species. When the sterile male insects mate with normal wild female insects, the mated females are incapable of producing

AFRICA'S TSETSE FLY

Test areas have been enclosed with cheesecloth-covered fences that deter the movement of tsetse flies.





ABOVE—Scientists inject tsetse fly males with a chemosterilant (top photo) before caging them with female flies. These mated females are later viewed under a microscope to check to see if they have been fertilized. BELOW—Researcher prepares a guinea pig, which serves as host animal during fly mating.

offspring. The sterile-male technique has been used successfully against several insect pests in other areas (see "Self-Annihilation of Insects," AGR. RES., January 1964, p. 6).

The researchers in Africa are concentrating now on *Glossina morsitans* and *Glossina pallidipes*. Success in sterilizing *G. morsitans*, one of the major spreaders of human and animal trypanosomiasis, has so far been achieved with two chemical sterilants, tepa and metepa. The sterilant apholate was unsuccessful.

Further investigations are planned in cooperation with ARC scientists to see if productive, self-sustaining colonies of tsetse flies can be reared in large cages constructed in the natural habitat of the insects.

One-acre areas are being enclosed as rearing cages at ARC's field station along the Zambesi River. Even larger ones may be used later. The cages are designed primarily to keep insects in, but they must also be protected from interference by elephants and other large game animals. Game fences and lion-proof stockades have, therefore, been constructed.

The scientists stress that the current experiments, part of feasibility studies only, cannot be expected to produce any immediate results in actual control of tsetse flies. If the tests succeed, more advanced experiments are planned, first against caged fly populations, and then in pilot tests against small isolated natural populations of tsetse flies.

The research team will also explore the development and use of attractants to lure native insects to chemosterilants placed in the field, thus eliminating mass rearing of tsetse flies for sterilization and release.☆

Stopping the Spread of . . .

WITCHWEED

A complex parasitic weed—of corn, sorghum, sugarcane—is confined to 34 counties

■ Witchweed—that innocent-looking parasitic plant that sucks the life out of corn—is losing ground in the battle being waged against it by ARS and the two States—North Carolina and South Carolina—where it has been a menace since 1956.

In 1964, for the first time since the control efforts started 9 years ago, no new counties were found infested with the parasite that got into this country—nobody knows how—and began its deadly work in several adjoining counties in these two States.

Because no new counties were found infested, ARS plant pest control officials believe the infestations have been stabilized by the control methods that started shortly after the weed was identified.

These methods have been aimed at destroying witchweed plants before they can produce the small seeds that make spread of the weed so easy. They have included yearly surveys to discover new infestations; continuing quarantines to regulate movement of commodities that might carry the seeds; and various programs to suppress and possibly eradicate known infestations.

The main control has been the use of 2,4-D to kill the plants before they produce seeds. Since 1958, ½ to 1 pound per acre of this chemical has been applied two or more times during each corn-growing season. With this treatment, ARS scientists say, there is no danger of a buildup of 2,4-D in the soil that would cause harmful residues on food and feed crops, and the dosage does not damage the corn in treated fields.

These cooperative controls have kept the witchweed from spreading beyond 24 counties in North Carolina and 10 counties in South Carolina.

The results of yearly surveys show that the number of newly infested farms has been declining since 1957. There were 2,184 newly infested farms in 1958; 2,167 in 1959; 1,885 in 1960; 1,587 in 1961; 971 in 1962; 831 in 1963; and only 693 new farms found infested in 1964.

When ARS and the State plant pest control officials started the campaign to control—and eventually eradicate—witchweed in the United States, they knew only a few of the things they would be up against, for they had had no experience with the parasite.

But reports of its damage to corn and other grass-family crops in Asia and Africa made them fear its spread into the U.S. Cornbelt and sugarcane-producing areas.

The campaign is not easy. Witchweed's almost microscopic seeds may lie dormant in the soil for many years and then suddenly germinate when the roots of a host plant come near them. These seeds are produced in enormous quantities—as many as half a million on one plant. Because of their minute size, they are easily scattered by wind, water, animals, and farm implements.

To germinate, a witchweed seed normally must be stimulated by secretions from roots of host plants—mainly corn, sorghum, and sugarcane. When the witchweed seedling starts to grow, its roots penetrate the roots of the host plant. The seedling depends upon the host for food and water until it emerges from the soil. After emergence, it turns green and man-

Witchweed roots attach themselves to the roots of the host plant for nourishment.

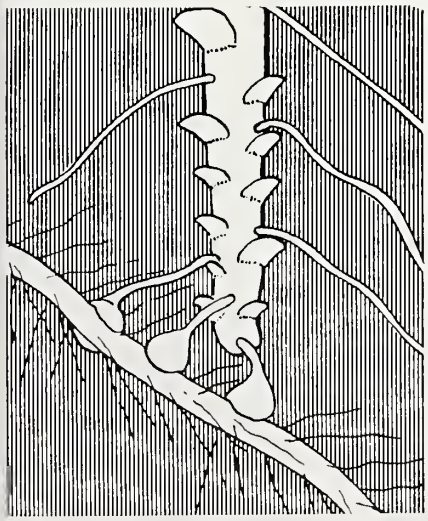
ufactures some of its own food but continues to depend upon the host for water and minerals and part of its food. The host plant, sapped of nourishment, weakens and later dies.

While working to keep the parasite confined to the area in which it was discovered, ARS constantly performed research to find better control and regulatory treatments. Tests are now being made that include preplanting and preemergence herbicides that might be used on corn, cotton, tobacco, and soybeans; and in soil fumigation to destroy seed.

Concentrated efforts are being made to isolate and identify the stimulant in host crops that trigger witchweed seed germination. ARS plant pest control officials believe eradication of the parasite could be speeded up if an economical substance could be found that would make witchweed seeds germinate independently of other plants. Without the host plants, the weed seedlings would soon die for lack of food.

Caution: In using insecticides, follow directions and heed precautions on the label, particularly where there is danger to wildlife or possible contamination of water supplies.☆

Sucking organs (haustoria) form at the ends of witchweed roots when in contact with host roots.



To cause flowering, apple is enclosed in plastic bag with plant for 4 days. Plant will bloom (see right foreground) in 1 to 6 months after bag and apple are removed.

Apples Cause Flowering

. . . *in common houseplant that rarely blooms*

■ Homemakers can turn a popular green houseplant, the bromeliad, into a bright-colored floral display—with a ripe apple and a plastic bag—says ARS horticulturist H. M. Cathey.

Simply put the plant in the bag, add the apple, close and tie the bag, and leave it alone for 4 days. Then remove the bag and the apple and take care of the plant as usual. In 1 to 6 months, depending on the species, the plant will produce beautifully colored blooms and fruits.

Bromeliads are pineapple plants (family, Bromeliacease), which are quite popular for indoor use. As houseplants, they rarely flower but are easily recognized by their cup-like crown formed by fleshy leaves surrounding the stem tip. There are many species, but homemakers usually know and buy them simply as bromeliads.

Cathey is a member of a Beltsville, Md., team working with plant-growth regulating compounds to tailor ornamentals to meet the desires of consumers (AGR. RES., September 1964, p. 8). After scientists in Hawaii had used B-hydroxyethyl hydrazine to make field-grown pineapples bloom and form fruit, Cathey used this chemical on greenhouse bromeliads.

Knowing that ripe apples give off ethylene gas, which has a chemical structure similar to that of B-hydroxyethyl hydrazine, he decided to test the apple as a natural source of growth regulator that could be used by homemakers themselves.

He tried it—and it worked. The bromeliads bloomed and formed fruits in 1 to 6 months. A treated bromeliad produces a large cluster of small flowers that vary in color even within species. Cathey is working with several species, including billbergia, aechmea, and vriesia, that produce blooms and fruits in a wide range of colors—orange, blue, lavender, yellow, green.

Ethylene gas has a bad effect on carnations, roses, and some other cut flowers. So don't keep them in the refrigerator with apples.☆

In Beltsville dietary studies, identical twin Angus has . . .

First Calf Born from Synthetic Diet . . .

■ An identical twin Angus cow is establishing some research landmarks in nutritional studies at Beltsville, Md.

The 930-pound cow hasn't had a mouthful of natural feed since she was weaned in November 1962—believed to be the longest period a ruminant has lived on a chemically pure (synthetic) ration.

And she gave birth to a 51-pound heifer calf, which was normal at birth but died suddenly when 16 days old—after gaining 29 pounds. (Exact cause of death was being investigated as this magazine approached press time. See next page, "Identical Twin Loses Calf . . . Why?")

ARS scientists fed the cow (No. 248) a diet containing urea as the only source of dietary nitrogen. A nonprotein organic compound, urea is made synthetically and has been used in limited amounts as a feed supplement for many years. The synthetic diet also includes corn starch, corn sugar, wood pulp (for bulk and energy), corn oil, minerals, and vitamins (see contrasting feeds, next page).

Animal husbandmen R. R. Oltjen, James Bond, P. A. Putnam, and R. E. Davis are conducting the experiment as the first in a series designed to obtain basic information of the dietary needs of ruminant animals for growth, reproduction, and lactation. Currently they are running laboratory studies on blood plasma and milk samples to determine how microbial protein produced from urea and other synthetic feeds is converted into vital amino acids used by the animals. Comparisons of this type are designed to find optimum conditions for the promotion of protein synthesis within the digestive tract.

Cow 248 has an identical twin sister (No. 247), which weighed 1,030 pounds at the time she gave birth to a 60-pound heifer calf. Both twins were bred artificially to the same bull. Cow 247 is on a diet of natural feeds—ground corn, alfalfa hay, orchardgrass hay, linseed meal, cottonseed meal, bone meal, and necessary vitamins and minerals.

The identical twin heifers were started on the experiment when they weighed about 290 pounds and were about 6 months old. Equal amounts of energy and nitrogen feeds were supplied daily, and feed intake was limited to keep the heifers gaining approximately 1 pound daily. Although a little reluctant to eat the synthetic ration at first, twin 248 responded satisfactorily and accepted her unusual diet in only 2 to 3 weeks.

Identical twins have been used by ARS scientists for more than a decade, primarily in nutritional studies but also in research on reproduction. Their use permits research at considerably less cost because comparisons between identical twins is equal to comparing many unrelated animals. Since they develop from a single fertilized cell—and have common inherited characteristics—identical twins not only look alike but they usually react in much the same way.

The loss of one of the calves quite naturally is a great disappointment to the researchers, who had remarked

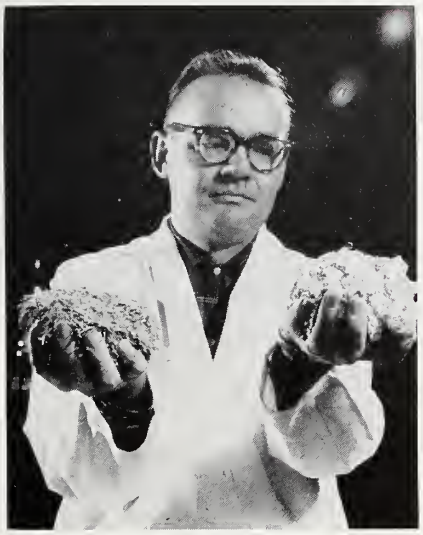
LEFT—Identical twin heifer at left is being fed natural feeds; the other twin (shown also on the cover with her calf) is on synthetic feed. Both twins had heifer calves by the same bull.

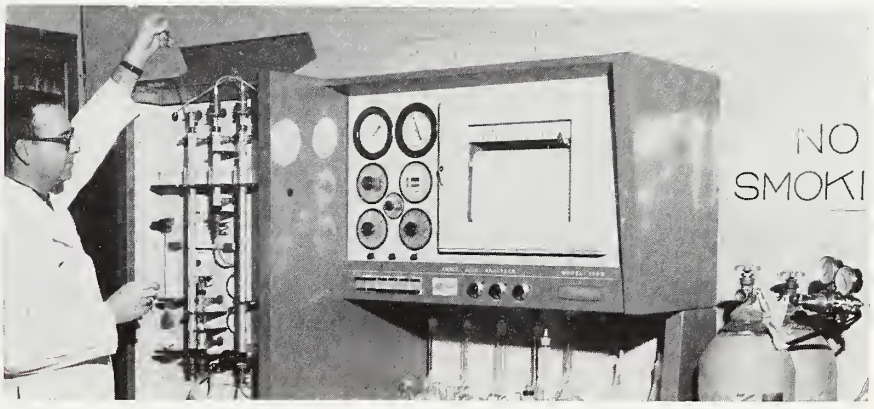
BELOW—Animal husbandman R. R. Oltjen displays contrasting feeds—synthetic (right) and natural—used in the nutrition studies.

earlier about the good fortune in getting a heifer calf from each of the twins. These calves were to have been kept with their dams until weaned and then fed the same diets as their dams—to test the effects of the diets on a second generation.

To offset the loss of the one calf, however, the scientists took immediate action. They substituted an Angus calf of almost the same age and weight—and having the same sire as the other two calves—to serve as proxy in the nutritional studies. The calf is now nursing its foster mother—the twin that has been on synthetic feed for nearly 2½ years.

The substitution will permit the researchers to continue to compare, among other things, the production and chemical composition of milk from the identical twins and the time required for each cow to conceive and produce a second calf.☆





Research technician L. K. Autry puts a sample of blood plasma in the amino acid analyzer as part of tests on how microbial protein is converted into amino acids. Other body fluids and tissue are also analyzed in the equipment.

Identical twin loses calf . . . Why?

Extensive post mortem examination of the calf born to the cow on synthetic feed failed to pinpoint cause of death. Although the Beltsville scientists examined body organs and fluids, they were unable to determine any abnormality or nutritional deficiency that could have caused death.

The calf appeared healthy and vigorous less than half an hour before the herdsman found it lying dead in its pen. In fact, the calf had gained 29 pounds during the 16 days it lived, about equal to the weight gained by the heifer calf born to the cow's identical twin on a diet of natural feeds. (Both calves were sired by the same bull, and both of them were nursing their respective dams at the time the calf died.)

Although the post mortem did not disclose it, the scientists say death possibly was of an accidental nature.

How much seedbed preparation?

Engineers study soil condition following plowing and

■ Many scientists are convinced that farmers would be money ahead if they would limit seedbed preparation to plowing—and only as much disking and harrowing as needed to eliminate surface roughness.

This conviction is supported—but not conclusively proved—by research findings of agricultural engineers W. G. Lovely of ARS, D. H. Luttrell of the Tennessee Agricultural Experiment Station, and C. W. Bockhop of the Iowa Agricultural Experiment Station.

These scientists conducted a series of tests to evaluate the operation of tillage tools in terms of changes in soil condition. They followed typical procedures used by farmers—plowing 6 to 8 inches deep and operating implements at 4 miles per hour. The tests were made on Colo silt loam and two complex soils—Clarion-Webster and Glenco-Webster—which if well drained are representative of productive, desirable soils for farming.

Disking and harrowing after plowing usually failed to break up clods—one of the main objectives of these operations. Clod size was not significantly reduced in six out of seven experiments.

Tillage after plowing also often failed to reduce soil density (compactness). In fact, disking and harrowing immediately after fall plowing actually compacted the soil. Changes in soil density generally were very slight, however; in one experiment, there was no significant change in density of the soil until the test plot had been disked three times.

Spring disking of fall-plowed soil reduced compaction slightly. But additional operations such as spike-tooth harrowing or repeated diskings tended to further compact the soil rather than loosen it.

The compactness of the soils before the tillage tests was not excessive, ranging from 1.15 to 1.29 grams per cubic centimeter. Plowing reduced this density of the soil approximately 25 percent—to a density range of 0.91 to 0.97 gm per cc.

The greatest contribution of disking and harrowing was in smoothing the surface of the ground after plowing. A smoother surfaced field resulted, despite failure to reduce clod size, because the implements tended to compact the soil. It has not been determined whether this smoother surface is needed for good seed emergence and plant growth, or whether some minimum degree of smoothness—with minimum tillage—is as satisfactory.

Two factors in seed and plant environment—soil temperature and moisture content—were also studied. Plowing, disking, and harrowing had

little or no effect on the changes in soil temperature or moisture that occurred during the first 10 days following the tillage operation. No attempt was made to determine the effect soil condition changes had on crop growth.

The scientists found that the effects of tillage on soil density, roughness, and clod size followed a pattern that was related to soil type. Plowing, disking, and harrowing decreased density and roughness and increased clod sizes more on the Colo soil than on either of the two complex soils—Clarion-Webster or Glenco-Webster.

In former years, the areas used in these ARS-State experiments had been planted to oats and corn (for grain or for silage). No relationship was found, however, between the kind of crop previously grown and the results obtained with the different tillage operations.☆

New profile meter records information automatically about . . .

SOIL SURFACE

■ The surface condition of soil after tillage tells scientists a lot about the effectiveness of the tillage operation. It has a direct bearing, for example, on rate of water absorption and resistance to wind and water erosion.

Although several instruments have been designed to get information about soil surface in an objective and standard manner, no available instrument met the specific need of two ARS engineers at Ames, Iowa. So they designed a new one.

The engineers, R. L. Schafer and W. G. Lovely, call the instrument a recording soil surface profile meter. This instrument has already been used in field experiments to measure (1) the roughness of the soil surface and (2) density of the tilled layer of soil.

In one experiment, almost 1,300 prod measurements were completed by two men in an hour, including the time required to move both the profile device and the frame. The average time required for making and recording a single prod measurement was 3 seconds.

The instrument is supported and held in place by an aluminum tripod (see photo). An aluminum frame, mounted on two of the tripod legs, acts as a "rail" on which the prodding device rolls back and forth horizontally. The prod itself, made of ¼-inch aluminum tubing, moves vertically a maximum of 18 inches, as it measures surface condition and soil density. Both horizontal and vertical movements of the prod are controlled by two electric motors operating automatically.

As measurements are taken, they are recorded mechanically. To meet the requirements of future experiments, Schafer, Lovely, and H. D. Currence, another ARS engineer, are modifying the recording mechanism so that it will punch measurements into computer cards immediately after a reading is taken. This should materially reduce the time required to compile and analyze the data obtained.☆

The automatic prodding instrument (center) rolls horizontally on rail as rod device moves vertically to measure surface condition and soil density.

Transmitting

Hoja Blanca

Research team develops strain of insects that will help detect rice disease

■ By selecting and breeding for a strain of insects with high potential for transmitting the rice disease hoja blanca, a team of four ARS scientists has a laboratory tool that could speed the development of disease-resistant varieties.

Working in cooperation with the Louisiana Agricultural Experiment Station at Baton Rouge, research technician R. D. Hendrick, entomologists T. R. Everett and W. B. Showers, and plant pathologist H. A. Lamey have produced a colony of rice delphacids (*Sogata orizicola*) that transmit the hoja blanca virus at a rate of nearly 100 percent.

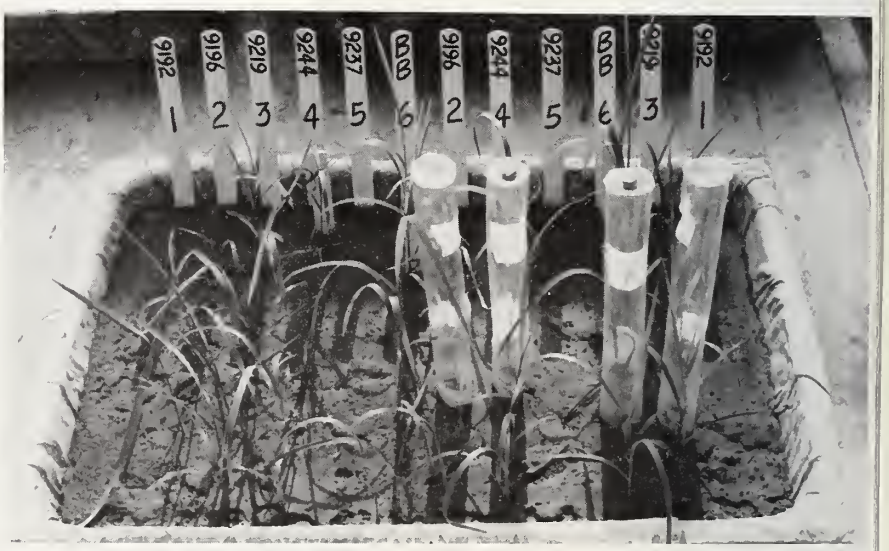
Both the disease and the delphacids—tiny, hopping sapsuckers—are serious pests of rice in Central and South America. They have been found in U.S. rice areas—and eradicated—at various times during the last few years. Although no evidence of either showed up in last year's survey, they pose a constant threat to rice production in this country.

Scientists have found it difficult to make transmission studies of hoja blanca because only about 7 to 15 percent of a natural population of delphacids transmit the virus. And finding active vectors is time consuming.

Five-day-old adult insects—which had been raised on diseased plants—were caged with uninfected rice plants that were 2 to 3 weeks old. Those insects on plants showing hoja blanca symptoms after 2 to 3 additional weeks were selected as active vectors of the disease. By then, however, the insects were 20 to 26 days old. And since the insects live an average of only 24 to 30 days, little or no time remained to use them as vectors in the transmission studies.

Now, the scientists rear nymphs on diseased plants and then cage 2d to 5th instar nymphs on uninfected 3- to 4-day-old rice plants. By starting with nymphs, which can also transmit the virus, they can increase by 8 to 14 days the time that vectors are available for transmission studies. Added time is saved by caging nymphs on younger indicator plans, which show disease symptoms earlier.

Using the new method, the researchers can identify active vectors in 4 to 10 days, leaving 20 to 27 days of adult life for research.☆



ABOVE—Researchers confine the tiny sapsucking insects on small rice plants in cellulose butyrate cages. BELOW—Tubes contain insects caged on rice plants in tests to determine plant resistance.

Scientists learn part played by leaves in bringing about . . .

Sugarcane Flowering

■ Scientists working to develop new strains of sugarcane are often frustrated by the fact that the hundreds of varieties flower at different times and under different conditions.

If breeders are to make crosses of certain desirable breeding lines, they must be able to control flowering. To do this, they need much more information about the flowering process itself—information of the sort obtained in recent experiments by ARS plant scientist R. E. Coleman, working in cooperation with the Hawaiian Sugar Planters' Association Experiment Station.

His work demonstrates the separate but interdependent roles played by the leaf spindle (completely furled leaves) and other leaves in bringing about flowering in sugarcane.

Scientists generally agree that leaves are the organs that perceive day length and produce a signal that moves to the newly developing tissue in the meristem. There the stimulus plays a role in the differentiation of cells into vegetative and flower parts.

Earlier work with sugarcane in Hawaii showed that this day-length perception, which determines rudimentary floral parts (initials), occurs from September 1 to 20. Floral development occurs after September 25, when initiation is complete and the rudimentary floral parts are visible upon dissection.

Coleman's findings show that although the spindle's essential role in the initiation of flower parts is played early in the differentiation period, it continues to influence flower development for 2 to 3 weeks.

Spindle removal on August 15, 22, or 29 significantly reduced floral initiation; removal after September 5 had no effect. Removal any time during August and up to September 19, however, reduced the percentage of plants having floral initials that developed complete flowers.

These responses to the spindle-trimming treatments indicate that the spindle's role in initiating flowers had largely been completed by August 29, but that it continued to influence flower development until September 19.

Leaves apparently complement the floral-initiation role of the spindle during August and carry on this role for about 2 weeks after the spindle has stopped its contribution. Coleman's findings further indicate that the leaf spindle is most essential to floral initiation about August 22 and that the leaves are most essential on September 12.

Response to leaf-trimming treatments indicates that during August the influence of the leaves on subsequent flower development is different from the influence of the spindle. Whereas spindle trimming during August reduced the percentage of floral initials that developed into complete flowers, leaf trimming during this same period increased the number of initials that flowered. Leaf removal after September 5 had no effect on subsequent flower development.

As a result of the Hawaiian studies, scientists know more about the time flowering stimulus is produced, the site of its production, and the nature of the contribution of the spindle and the leaves.

Further studies are now being made to determine the separate biochemical functions of these plant parts. The scientists hope that basic information such as this can someday be applied to the practical problem of controlling flowering and thus expand the possibilities for new and better strains of sugarcane.☆

Do Boll Weevils Reject Cotton Squares?

Yes, when squares are treated with extract from rose of sharon

■ ARS scientists can make the boll weevil turn up his nose—in a manner of speaking—at cotton squares (flower buds) by treating them with a substance extracted from the calyx of the rose of sharon, a landscaping shrub that is a relative of the cotton plant.

Although the substance has not been chemically identified, it is water-soluble—and is easily obtained by soaking rose of sharon calyxes in water.

Entomologists F. G. Maxwell and W. L. Parrott and plant geneticists J. N. Jenkins and H. N. Lafever report that the substance reduced boll weevil feeding significantly for more than 20 hours when painted on cotton squares. They extracted and tested the feeding deterrent in cooperative research with the Mississippi Agricultural Experiment Station.

In future investigations, the scientists hope to develop ways of using the feeding deterrent to control the boll weevil. It is one of several biologically active plant extracts having potential practical value which ARS scientists are studying at the Boll Weevil Research Laboratory, State College, Miss.

The scientists started the feeding deterrent studies after they noted that the boll weevil made few feeding punctures on rose of sharon buds while they were completely encased in their calyxes before blooming.

Once the calyxes were removed, however, the insects fed and deposited eggs as readily in the rose of sharon buds as on cotton squares, their favorite diet. Since the calyx is not a structural barrier to weevils, scientists reasoned that the calyx of rose of sharon contains a feeding deterrent.

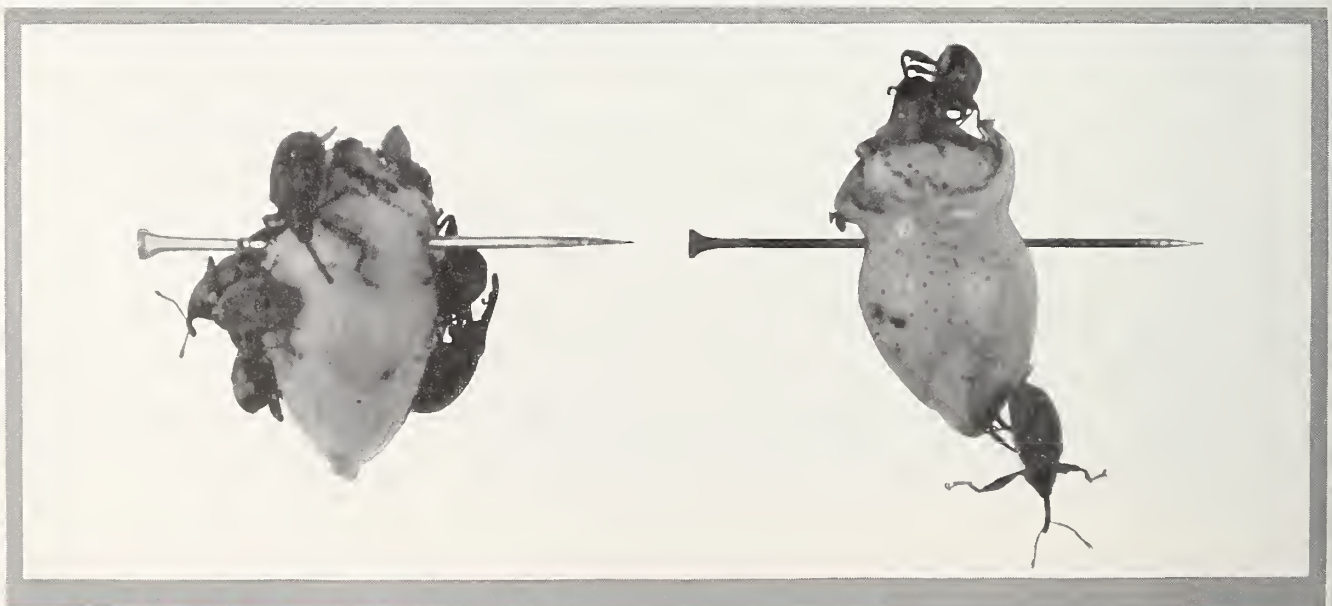
Painting cotton squares with an extract of the deterrent significantly reduced feeding for more than 20 hours. For example, in one 20-hour test, the average number of feeding punctures on painted cotton squares was only one-tenth the number on untreated squares.

The researchers also conducted experiments to determine what value the deterrent might have in masking the effects of the strong feeding stimulant known to exist in cotton. They tested various mixtures of deterrent and stimulant in agar plugs.

In all cases where the amount of deterrent equalled or exceeded the stimulant, feeding went down significantly. In a 20-hour test in which 2½ times as much deterrent as stimulant was used, the effect of the stimulant was masked and the number of feeding punctures observed was about the same as when the stimulant was not used at all. Increasing the ratio even more reduced feeding to a level below that on untreated plugs.

Scientists ran still other tests using various concentrations of the deterrent on agar plugs without the stimulant. At the highest concentration tested, only 2 feeding punctures were made by 10 boll weevils over a 20-hour period, compared with 92 punctures on the untreated control. The researchers consider it likely that still higher concentrations could eliminate feeding entirely.☆

Cotton square at right was treated with feeding deterrent from rose of sharon calyx, the one at left with distilled water. Weevils move around on treated square, but they do not stay to feed.



Artificial freeze screens citrus

Subjecting young seedlings to an artificial freeze appears promising as a technique for screening citrus hybrids for cold hardiness.

ARS plant physiologists R. H. Young and W. C. Cooper are doing the artificial freezing research in cooperation with the Texas Agricultural Experiment Station at Weslaco.

Young and Cooper hardened (increased the cold resistance) of 9-month-old citrus seedlings under controlled conditions, then exposed the seedlings to a low temperature (20° F.) for 4 hours. The order of cold damage to these citrus types was surprisingly close to the order of damage to the same types of 9-year-old trees following a severe natural freeze in Texas in 1962.

This indicates that seedlings grown and hardened in pots should behave relatively the same way as large trees of the same type grown in the field. But additional research is needed to verify the accuracy of the technique.

The scientists point out that there were essentially no replications in their first tests because they used hybrid material and each plant was genetically different. In tests now being conducted, the needed replications are assured by using plants of a single genetic type that have been multipled by vegetative propagation.

An accurate artificial method of screening seedlings would be important to the citrus industry, which has an expanded breeding program underway. Thousands of new hybrids are being produced annually, many need to be screened for cold hardiness.

The present screening technique calls for planting the hybrids in the field, then waiting for a natural freeze to occur. This method has serious disadvantages because considerable land, labor, and money are required to maintain the plants. In addition, natural freezes cannot be controlled and are often too severe or too mild for meaningful screening.

Luring moths to blacklight traps

Another way of tricking insects into destroying themselves is being explored by ARS scientists.

This time, they're using unmated female moths of the tobacco hornworm species to attract male moths to blacklight field traps.

In studies at Oxford, N.C., each additional female moth, up to a maximum of 10, was just as effective in attracting male moths as installing an additional 15-watt light trap.

Blacklight traps and unmated female moths attracted as many as 48 male moths to a single trap in one night.

The results of one experiment illustrate this attraction: In traps without female moths, an average of four male moths were caught each night. When 2 females were placed in the trap, the average nightly catch was 13 male moths. Six females raised the catch to 24 males, and 10 females brought in an average of 48 males.

The virgin female moths were held in small cages placed on the ground, in the trap cages, or 20 feet above the ground. Position of the cages had little effect on the number of male moths caught as long as the females were kept within 15 feet of the light trap. The caged moths were fed sugar solution each day and kept in a shady cool place during daylight hours.

The traps used in these experiments were located in open areas at least a mile apart. Each trap consists of a fluorescent lamp that attracts the hornworm moths and a device to prevent their escape. The light emitted is frequently called blacklight because the rays are in the near-ultraviolet range invisible to humans. A single 18-inch, 15-watt lamp is mounted vertically at the juncture of four sheet-metal baffles located above a funnel.

Moths attracted to the trap dive into the funnel or strike the baffles and fall through the funnel into a screen cage. Sides of the cage are made of ⅓-inch-mesh screening, which retains hornworm moths but allows smaller insects to escape.

The experiments were conducted by ARS entomologists and agricultural engineers in cooperation with the North Carolina Agricultural Experiment Station and tobacco farmers at Oxford.

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AGRISEARCH NOTES

Nutrition data now on punchcards

Nutrition data for almost 2,500 food items have been put on magnetic tapes and punchcards by ARS statisticians for use by nutritionists and research workers to compute, electronically, the nutritional value of diets. This makes possible high-speed, low-cost analysis of nutritional information needed to study trends in our national food supply, to appraise adequacy of the diets of population groups, and to plan diets in hospitals, schools, and other institutions.

Elizabeth Davenport and Donald F. Miller, working with the staff of the Statistical Reporting Service's Data Processing Center, recorded on the cards and tapes data on the nutrients in the edible portion of 100 grams of food and in 1 pound of food as purchased. The data, suitable for computing the nutrients in household or institution food supplies, was taken from Agricultural Handbook 8, "Composition of Foods" (see AGR. RES., November 1964, p. 5).

A smaller set of punchcards was prepared with data expressed in common household measures, such as tablespoons, cups, or slices—suitable for calculating diets of individuals. Data on these cards is from "Nutritive Value of Foods" (HG 72).

For example: A research worker using an automatic computer to assess the nutritional value of foods served to students during a week would choose either of the sets of data prepared by ARS, depending on the units of measure used in the school—pounds or the smaller measured portions. On another set of cards or tape, he would record the amounts of various foods served during the week. The two sets of data would then be fed into the computer, which multiplies the quantities of food by the nutrients in specified amounts of food—and totals each nutrient (calcium, protein, etc.) which all the foods contain.

A description of punchcard specifications for Handbook 8 data—and instructions explaining the use of the punch cards for machine tabulation based on HG 72 data—may be obtained from the Consumer and Food Economics Research Division, ARS, Federal Center Building, Hyattsville, Md., 20781. Forms are included for ordering the cards or tapes.

How selective IS insect feeding?

The cabbage butterfly seeks out the cabbage patch in the garden to deposit its eggs. The caterpillars that hatch from the eggs eat and grow to maturity on the plants selected by the parent butterfly.

If the caterpillars are placed on other plants to which they are not accustomed, they go on a hunger strike, doggedly refusing to eat, and finally perish miserably in the midst of plenty.

How selective are such feeding habits of insects? And could insects be tricked into feeding on substitute diets—perhaps containing an insecticide?

These are penetrating questions, and ARS entomologists J. C. Keller and T. B. Davich have begun to obtain the answers. They induced five insects to feed on agar containing a water-soluble substance extracted from the plant host of each insect.

They experimented with the Monarch butterfly on milkweed, the elm leaf beetle on American elm, a species of *Gastrophysa* on dock, the squash bug on pumpkin, and the boll weevil on cotton squares.

The researchers obtained water extracts from each of the plants and mixed the extract with agar. When the mixture had cooled in petri dishes, half of the jelled extract was removed from each dish and replaced with jelled agar water without the extract. The scientists placed insects in each dish, observed feeding for 8 hours.

The test insects fed extensively on the portion of agar containing extracts from their plants host, in contrast to little or no feeding on the portion containing extracts from other plants—or on the jelled agar water.

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